SECTION C — (3 × 10 = 30 marks)

Answer any THREE questions.

16. Discuss the conservation laws (linear momentum, angular momentum and energy) for a system of particles.

17. Deduce the Lagrangian equation for Atwoods machine.

18. Derive Hamiltons equation for motion of a particle in a central force field.

19. Deduce the Lagrange's equation of small oscillation.

20. State and explain Einstein's mass-energy relation ($E = mc^2$). Discuss its implications in physics and provide an example of its application.

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**NOVEMBER/DECEMBER 2024**

# 23PPH12 — CLASSICAL MECHANICS AND RELATIVITY

Time : Three hours Maximum : 75 marks

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SECTION A — (10 × 2 = 20 marks)

Answer ALL questions.

1. Define holonomic and non-holonomic constraints in the context of mechanics.

2. State principle of virtual work.

3. State the Lagrangian equation of motion for conservative systems.

4. Mention D'Alembert's principle.

5. What are cyclic coordinates? Provide and example.

6. What do you mean by phase space?

7. What is Lagrange's equation of small oscillations?

8. In the context of small oscillations, how does the parallel pendulum function?

9. Write the Lorentz transformation equations for time.

10. Define Minkowski space.

SECTION B — (5 × 5 = 25 marks)

Answer ALL questions.

11. (a) Compare the mechanics of a single particle with that of a system of particles.

Or

(b) Describe transformation equations and their relation to generalized coordinates in mechanics.

12. (a) Explain D'Alembert's principle and its significance in the formulation of equations of motion for mechanical systems.

Or

(b) Using Lagrangian mechanics, derive the equations of motion for a compound pendulum.



13. (a) Describe generalized momentum (conjugate momentum) in the context of Lagrangian mechanics. How does it relate to the action principle?

Or

(b) How do Hamilton's equations differ from Lagrange's equations? Discuss the advantages of using Hamiltonian mechanics.

14. (a) Outline the concepts of stable and unstable equilibrium, and illustrate them with equations.

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Or

(b) Elaborate the normal modes of vibration in a linear triatomic molecule.

15. (a) Provide a derivation of the Lorentz transformation equations and explain their role in the context of special relativity.

Or

(b) Differentiate initial and non-inertial frames.